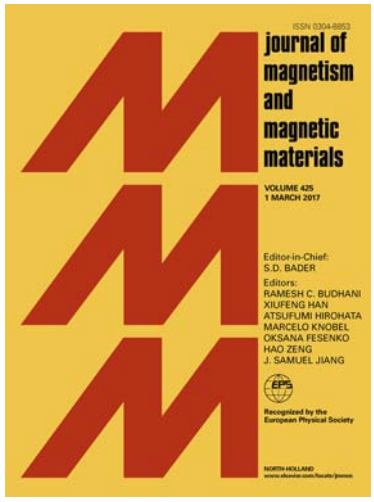

Magnetization Reversal and Exchange Bias Study in Bulk $Gd_{1-x}Y_xCrO_3$ (x = 0.0 – 1.0)

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Magnetization Reversal and Exchange Bias Study in Bulk $Gd_{1-x}Y_xCrO_3$ (x = 0.0 – 1.0)

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Abstract

Single phase samples of $Gd_{1-x}Y_xCrO_3$ (x = 0.0 – 1.0) were prepared by sol-gel method. Lattice parameters obtained from the Rietveld refinement are found to decrease from a = 5.3129 Å, b = 5.5210 Å, and c = 7.6040 Å for x = 0 to a = 5.2428 Å, b = 5.5208 Å and c = 7.5340 Å for x = 1.0. The temperature variation of magnetization measurements show that all samples exhibit antiferromagnetic transitions and the Neel temperature (T_N) decreases from T_N = 174 K for x = 0.0 to 142 K for x = 1.0. Interesting magnetization reversal behavior is observed as the temperature is lowered from T_N under field cooled condition and the magnetic compensation temperature, T_{comp} is found to decrease from 136 K for x = 0 to 42 K for x = 0.70. These samples exhibit tunable positive and negative exchange bias fields with a maximum negative value of -1.17 kOe for x = 0.50. The origin of magnetization reversal and exchange bias field is explained by considering the competition between the paramagnetic moment of Gd^{3+} ions under the influence of negative internal field and the weak ferromagnetic component of Cr^{3+} ions due to canted antiferromagnetic ordering.

Keywords: Orthochromites; Weak ferromagnetism; Magnetization reversal; Tunable exchange bias.

I. Introduction

The study of exchange bias has drawn a great deal of interest due to its potential technological applications in magnetic recording devices, spin valves, spintronic devices and in magnetic random access memory devices [1–7]. The Exchange Bias (EB) in a system is manifested as a shift in the center of the isothermal magnetic hysteresis loop towards either positive or negative field axis. Such shifting towards positive and negative field axes is known as positive exchange bias (PEB) and negative exchange bias (NEB) respectively. This behavior is mainly observed in various heterostructured system having bilayer and multilayer of ferromagnet (FM)/antiferromagnet (AFM), FM/ferrimagnet (FIM), etc. [1,7–10]. The EB arises as a result of

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